Chesterfield County, Virginia

Memorandum

DATE: January 8, 2007

TO: Chesterfield County Planning Commission

FROM: Richard McElfish, Director of Environmental Engineering
Scott Flanigan, Water Quality Manager

SUBJECT: Status Report -
Swift Creek Reservoir Watershed Master Plan and Maintenance Program

During the July 18, 2006 CPC work session on the Upper Swift Creek Plan, commissioners requested monthly progress updates on issues regarding the **Swift Creek Reservoir Watershed Master Plan** (*Watershed Master Plan*). Staff provided, during the August 15, 2006 work session, a framework of tasks and steps needed to address regulatory issues concerning the *Watershed Master Plan* and options and alternatives for a path forward. The tasks are divided into three phases – short-term, near-term and long-term – and will be conducted concurrently with the phases indicating expected schedule for completion.

The attached document details the progress made on those short-term topics outlined at the prior session and addresses the additional concerns raised during the sessions. Due to the complexity of the tasks, the information from previous work sessions will be brought forward as part of the on-going 'Status Reports'. New information or progress will be reported under each of the tasks. This current information will be express in lettering that is ***bold and italicized***.

The focus of the January 16, 2007 work session will be a presentation of the analysis of the watershed model. The results and comparisons are currently under review by CH2MHill. As of this memo, county staff has not received any of the information on the analysis of the review. Only after a complete staff review, can a presentation for the CPC be completed. Should the information and analysis be received in a timely manner, staff will provide a presentation that addresses work that has been completed. Additional information is provided in section d.iii below.

Attachments
Document A:
Document B: Concerns or questions raised by the commissioners during work sessions
Document C: Near-term and long-term tasks to be discussed a future work sessions

c: Lane Ramsey
Pete Stith
Kirk Turner

1. Short-term (should be addressed in the period ending December 2006)

The tasks outlined below are to address on-site stormwater management and the issues generated by these changes. The information gained in modeling current land-use and predicted development and its impact on water quality will be used to guide future decisions.

a. County Ordinances

The Planning Commission heard the proposed amendments during the October 17, 2006 Public Hearing. The Planning Commission recommended approval of the proposed changes to the Board of Supervisors (BOS). Prior to the Board of Supervisors meeting, Staff held a citizen informational meeting on November 2nd to discuss the proposed changes. For current information please contact the Department of Environmental Engineering.

A public hearing to consider the proposed amendments to the water quality ordinances in the Upper Swift Creek Watershed was brought before the Board of Supervisors at the December 13, 2006 meeting. A decision to defer consideration of the proposed amendments was made until the March 2007 meeting. Prior to the March 2007 Public Hearing, staff has been asked to provide a work session to the BOS detailing the amendments and future direction with respect to the Upper Swift Creek Master Plan.

i. Upper Swift Creek Watershed Ordinance and others

Adopt amendments to zoning and other ordinances, as necessary, which would require development to treat stormwater runoff onsite and/or to implement other remedies.

Sec. 19-237. Upper Swift Creek Watershed

Sec. 19-238. Development regulations - A draft-modified ordinance has been developed for review. The major modifications include (1) the requirements for on-site stormwater treatment and (2) the availability of other mitigation measures for on-site treatment equal to the required pollutant removal for that development.

Sec. 19-238.5. Boundary adjustments, Sec. 19-239. Exemptions, and Sec. 19-240. Exceptions – Sections were considered redundant with respect to Division 4. Chesapeake Bay Preservation Areas, therefore the sections were deleted.

ii. Pro-rata Share Program

Adopt amendments to the funding ordinances, as necessary to address contributions, fee structure and accounts for developments that are under construction or in the review process.

Sec. 12-71. Purpose and intent of article, Sec. 12-72 Basis for the pro-rata share fee, Sec. 12-73 Pro-rata share contributions, Sec. 12-74 Pro-rata share accounts, and Sec. 12-75. Pro-rata fee payments - The ability for the county to require payment as part of the current Watershed Master Plan will no longer be available, therefore these sections were deleted. For

developments considered vested under the current program, payment will still be an option as a means for stormwater treatment.

iii. Best Management Practice (BMP) Maintenance Fee

Adopt amendments to the funding ordinances, as necessary, to address contributions, fee structure and accounts for current BMP maintenance program. The maintenance fee per residential unit would remain. A fee may be added for sites.

iv. Maintaining Silt Basins On-site

Adopt amendments to address that section of the erosion and sediment control ordinance pertaining to the Swift Creek Reservoir, which requires sediment basins to be maintained on-site until a permit to allow construction for a regional facility has been received.

Sec. 8-8. Responsibility for the erosion and sediment control plan – The section has been amended to require sediment basins to remain on-site until compliance with 12-238(d)(1) has been achieved.

b. County Program Policy

Review current program policies, which may allow for alternatives for stormwater treatment and loading outside of current ordinances. An example of this, would be, implementation of the current pollutant credit program already in use outside of the Swift Creek Reservoir Watershed. Environmental Engineering credit program consists of BMP facilities that have additional unused treatment capacity. The additional capacity is converted to phosphorous credits that the owner may sell.

Environmental Engineering policy concerning the existing pollutant credit program has been modified to allow participation of developments only within the Swift Creek Reservoir Watershed and it sub-watersheds. This program will be available once the necessary ordinances requiring on-site stormwater controls have been adopted.

c. Zoning Cases

i. Future Zoning Cases

As a condition of any future zoning case, staff will request a proffer that all stormwater management will be addressed onsite until such time that the county can develop a revised regional approach to treat stormwater.

ii. Property Already Zoned and in the Development Phase

Provide technical guidance on stormwater management and site development that can be implemented within the context of existing ordinances.

iii. Property Already Zoned and not in the Development Phase

Stormwater management impacts should be addressed onsite until such time that the county can develop a revised regional approach to treat stormwater.

d. Determine Annual Phosphorus Load Contributions to Reservoir

As a result of concerns involving the validity of the P-8 (model for predicting the generation and transport of stormwater runoff pollutants in urban watersheds) and Reckhow (empirical model used to predict median in-lake phosphorus in southeastern impoundments) models during the August 15, 2006 CPC work session, additional tasks were added to address model calibration and validation.

Model calibration is defined by the Environmental Protection Agency (EPA) as "testing and tuning of a model to a set of field data not used in the development of the model; also includes minimization of deviations between measured field conditions and output of a model by selecting appropriate model coefficients."

Model validation is defined by the EPA as "subsequent testing of a precalibrated model to additional field data, usually under different external conditions, to further examine the model's ability to predict future conditions."

The "Swift Creek Reservoir Watershed Master Plan", in 2000, calibrated the tributary P-8 models based on two parameters. The first was the flow related to rainfall events. The total runoff volume is the most important result of the flow modeling. It is used as a direct input to the Reckhow model. As reported in 2000, modeled storm flow was compared to flow data from the Tomahawk Creek monitoring station. It was determined at the time that while the model tended to over predict small to medium spring storms and under predict small to medium summer storms, the model accurately predicted large storms and the total runoff volume. Based on these results, it was decided that no further calibration for flow was required.

The second parameter is total phosphorus (TP). The total annual TP load is also used as a direct input to the Reckhow model. As reported in 2000, modeled annual average concentration for each tributary model was compared to the measured annual concentration for all monitoring stations. Calibration was achieved by adjusting the scaling factor for each model.

i. Model Calibration and Validation (expected time of completion Mid October)

The purpose of this task is to verify that the flow and total phosphorus (TP) calibration conducted previously (based on 1999 land use and precipitation) is appropriate and to validate the calibration with 2003 land use and precipitation data. The 1999 land use calibration verification and the 2003 land use validation will consist primarily of comparing the P-8 data from three tributary models with the flow and TP data collected at the Department of Utilities' monitoring stations. The final step is to compare the Reckhow model output with the observed water quality data from the reservoir. This will confirm the ability to predict runoff and TP load on an annual basis and use those results as input to an independent model that in turn predicts the average in-lake TP.

The three tributaries selected for the analysis are Little Tomahawk Creek (LTC), West Branch Creek (WBC), and Fuqua Branch at Ashbrook Lake (ASH). These three tributaries were selected because these monitoring stations experience little or no over bank flooding or reservoir backwater conditions, both of which can be detrimental to flow measurements. ***They*** were also selected because of their relatively different stages of development within the respective watersheds.

The 1999 land use calibration verification was conducted by using flow data from previous models for LTC, WBC, and ASH. The modeled flow was compared to the actual flow observed at the corresponding monitoring station. The TP calibration was verified by comparing the modeled annual average TP concentration with the values observed at the monitoring stations.

The 2003 land use validation was conducted in a manner similar to the 1999 calibration verification. The first step was to update any of the previously run 2003 land use P-8 models based on changes made during the 1999 calibration verification process. Next the models were rerun and the flow data was compared to the monitoring data from 2003 for LTC, WBC, and ASH. The next step compared the predicted annual average TP concentration with the available monitoring data.

Finally, the Reckhow model output will be compared to the observed water quality data from the reservoir. This will confirm the ability of the model to predict runoff and TP load on an annual basis and use those results as input to an independent model that in turn predicts the average in-lake TP.

The results and comparisons were presented during the November CPC work session.

ii. Current Annual Total Phosphorus Loads (expected completion – early November)

Model current developed land to determine projected annual loads.

The purpose of this task is to provide an updated load calculation for TP based on the most recently available land use. Current land use that is based on the 2005 parcel data and is consistent with the previous land use layers (1999 and 2003) will be developed and modeled. The P-8 models previously used for the 2003 land use validation runs will be updated based on the 2005-land use and run. The 2005 land use validation will consist primarily of comparing the P-8 data from three tributary models with the flow and TP data collected at the Department of Utilities' monitoring stations. The annual flow and TP load output from all of the models will be input into the Reckhow model and the results will be compared to the in lake monitoring data for additional validation.

The results and comparisons were presented during the November CPC work session.

iii. Predicted Annual Total Phosphorus Loads (expected completion–early December)

Determine annual phosphorus load contributions from Powhatan County, property rezoned, in the site review process, tentative process or those developments that may be considered vested under current "Swift Creek Reservoir Watershed Master Plan."

The purpose of this task is to assess the worse case scenario involving all parcels that are approved for development but not yet developed. It will assess the impact to the reservoir if all of these parcels are developed but none of the original regional ponds are constructed to remove TP. This task will look at two cases. Case 1 considers all of the zoned parcels. Case 2 considers all of the zoned parcels and their known requirements and proffers.

Case 1. All Zoned Parcels
The Case 1 model is based on 2005 land use. CH2M HILL and county staff will work together to convert Powhatan County existing land use to future land use based on their latest comprehensive plan. Chesterfield County land use will be updated based on approved and tentative zoning data (July 2006). Tributary P-8 Models will be run for the revised land use.

Existing and proposed BMPs will be modeled in the same manner as the Current Land Use (2005) Load Calculation Task. The resulting load and flows will be input into the Reckhow Model and the results discussed.

Case 2. All Zoned Parcels and Known Requirements and Proffers
The Case 2 model is based on the land use developed for Case 1. CH2M HILL will review all known requirements and proffers with county staff to determine the best method of accounting for them. Loads will be adjusted accordingly either within the P-8 models or post modeling. The resulting loads and flows will be input into the Reckhow model and the results discussed.

The results and comparisons are under review by CH2MHill.

iv. Determine the Reduction in Annual Total Phosphorus Loads

Similarly, determine annual phosphorus load removal associated with existing on-site controls, existing BMPs and new/anticipated RPAs.

Existing BMP removals will be calculated post modeling. Loads for each tributary watershed will be reduced according to the BMPs located within each watershed.

Existing BMP removals will be calculated post modeling due to the size limitations of the P-8 model. These size limitations include both the number of BMPs and the number of subwatersheds that can be modeled. BMP removals will be calculated based on data including: location, drainage area, percent impervious for each drainage area, and design removal efficiency for each BMP. Loads for each tributary watershed will be reduced according to the BMPs located within each watershed.

The post BMP results for LTC, WBC, and ASH will be compared to the 2005 monitoring data for additional model validation. The annual flow and TP load output from all of the models will be input into the Reckhow model and the results will be compared to the in lake monitoring data for additional validation.

v. Determine the predicted in-lake TP Concentrations

This is critical to ensure that net annual phosphorus load does not exceed projected contribution (25,000 lbs/yr) based on current modeling. A projected load greater than 25,000 lbs/yr could result in exceeding the recommended county criteria of 0.05 mg/L or the pending State Water Quality Standard of 0.04 mg/L for an in-lake TP concentration.

The resulting TP load and projected in-lake TP concentration will be provided with each of the above land use calculations.

vi. 0.22 lb/yr – P-8 Correlation

The purpose of this task is to determine a method that will allow the County to compare the modeling and loading calculations that were developed for the Swift Creek Reservoir Watershed Master Plan with the calculations that are used by developers to meet the Chesapeake Bay requirements.

e. Regional Pond Facility

Submit expanded alternatives assessment to the Army Corps of Engineers, USEPA, USFWS, and VA DEQ as part of ongoing efforts to obtain permits for modified Charter Colony pond(s).

An Alternatives Analysis for LTC30 and LTC20/25 has been completed and submitted to the regulatory agencies for review. This was to address agencies' concerns as part of the permitting process.

f. Powhatan County

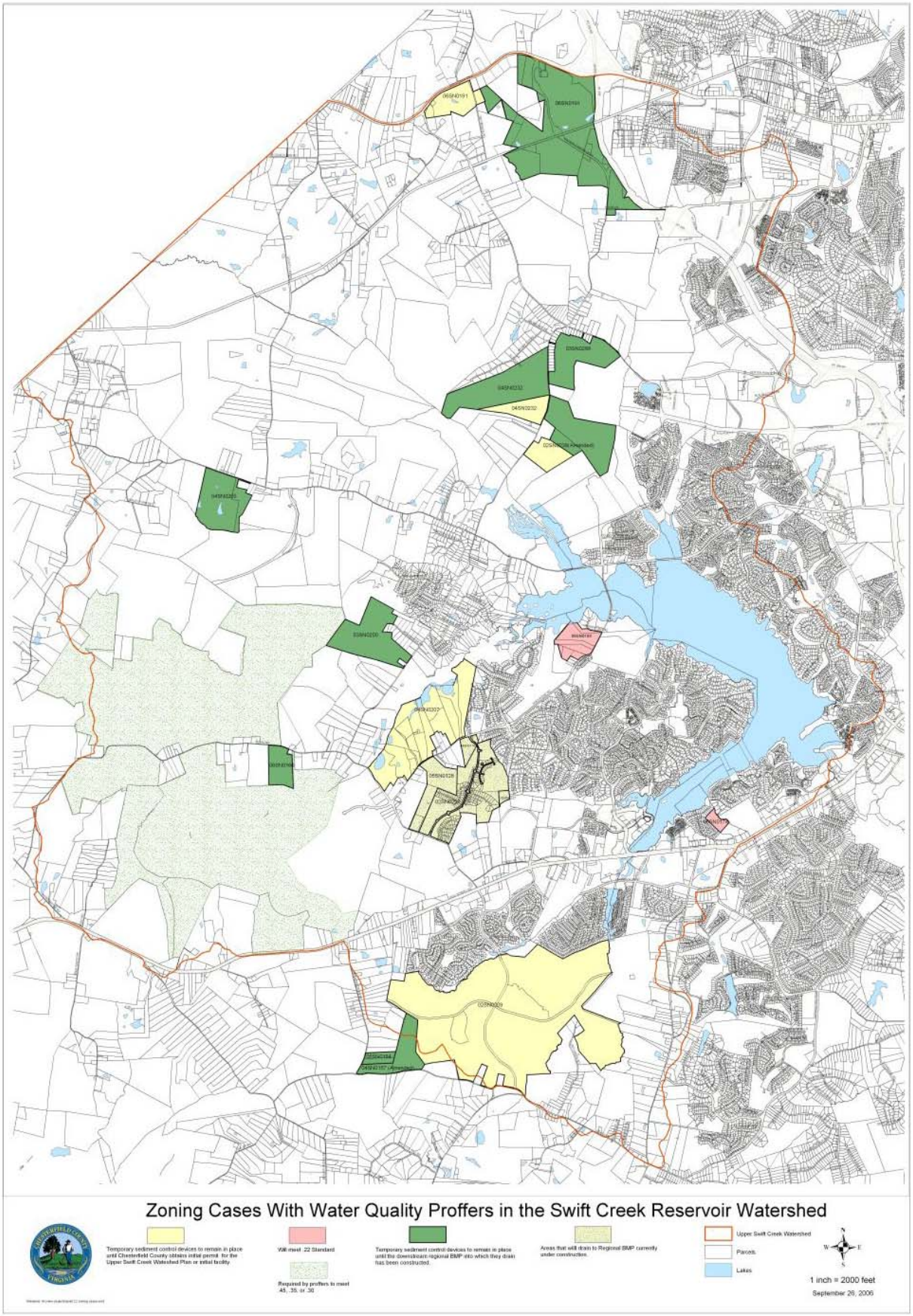
Determine Powhatan County's current land-use plan and its impact on water quality in the Reservoir. Information on the Powhatan's land-use plan will be needed to determine TP loading in (c.ii.) above.

The current development and future land-use plan has been updated and placed into GIS. This information will be used as part of the modeling process as necessary.

DOCUMENT B
Concerns or questions raised by the commissioners

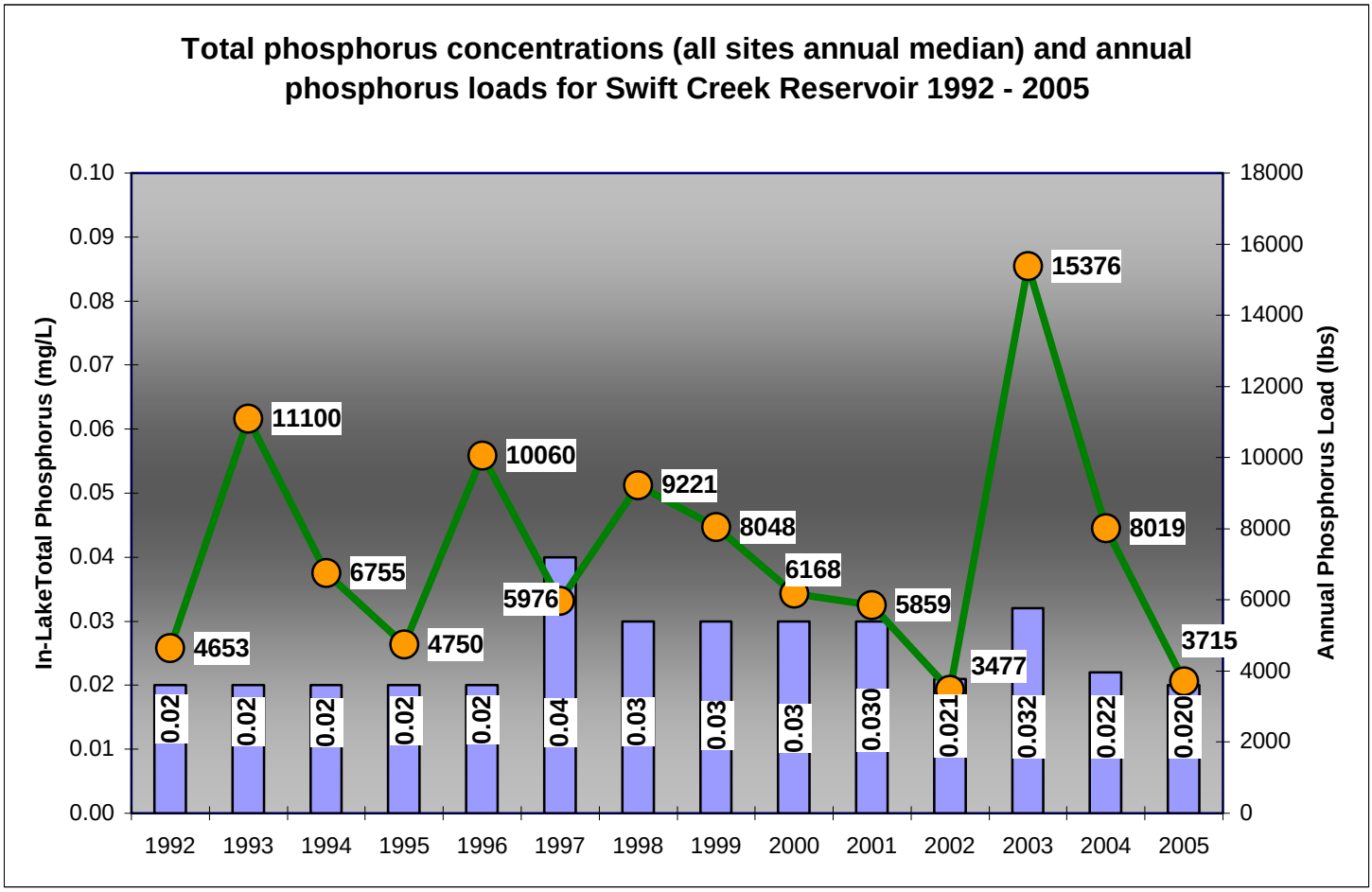
October 17, 2006 CPC Public Hearing

a. During the public hearing, there was concern as to how the proposed ordinance amendments would affect those properties within the Swift Creek Reservoir Watershed having water quality proffers. The figure below details the parcels affected and their proffers.


Zoning Cases With Water Quality Proffers in the Swift Creek Reservoir Watershed
Temporary sediment control devices to remain in place until Chesterfield County obtains initial permit for the Upper Swift Creek Watershed Plan or initial facility
Will meet .22 Standard
Temporary sediment control devices to remain in place until the downstream regional BMP into which they drain has been constructed.
Areas that will drain to Regional BMP currently under construction.
Upper Swift Creek Watershed
Parcels
Lakes
Required by proffers to meet .45, .35, or .30
1 inch = 2000 feet
September 26, 2006

August 15, 2006 CPC Work Session

a. There was a request for a graph, which compared annual median total phosphorus (TP) concentrations in the Reservoir and the annual watershed TP loadings (total from the eight tributaries) for the years 1992-2005.



b. There was concern expressed that stormwater management facilities or BMPs may not actually achieve the assigned pollutant removal efficiency.

Stormwater management facilities or BMPs designs are required to meet the technical design and specifications and maintenance requirements as defined in the Virginia Stormwater Management Handbook (DCR, 1999). "These criterion were derived from available sources such as the Northern Virginia BMP Handbook, Hampton Roads BMP Handbook, and various other publications, including those from the Metropolitan Washington Council of Governments and the Center for Watershed Protection. These minimum standards represent current, and in some cases innovative, design information pulled together under one cover in order to promote consistency in the design and construction, and therefore the effectiveness, of stormwater BMPs." The table below outlines the water quality pollutant removal efficiencies.

Water Quality BMP Pollutant Removal Efficiencies	
Water Quality BMP	**Target Pollutant Removal Efficiency**
Constructed wetlands	30%
Bioretention basin	50%
Bioretention filter	50%
Extended detention (2 x WQ Vol)	35%
Extended detention-enhanced	50%
Retention basin I (3 x WQ Vol)	40%
Retention basin II (4 x WQ Vol)	50%
Retention basin III (4 x WQ Vol with aquatic bench)	65%
Sand filter	65%
Infiltration (1 x WQ Vol)	50%
Infiltration (2 x WQ Vol)	65%

DOCUMENT C
Near-term and long-term tasks to be discussed a future work sessions

2. **Near-term (should be addressed in the period ending June 2007)**

The tasks outlined below are to address on-site stormwater management and the direction and modification to the *Watershed Master Plan*. Any modifications to the current plan would require Board of Supervisor's approval.

a. Non-conventional Stormwater Treatment Designs

Upon amending the Upper Swift Creek Watershed Ordinance, residential uses would be required to meet phosphorus loading not to exceed 0.22 lbs/ac/yr. Some of the developments will be unable to meet the 0.22 lbs/ac/yr loading using conventional onsite stormwater treatment facilities (i.e. ponds). Therefore the county would need to develop ordinances or policies to address the non-conventional treatment systems such as Low Impact Development (LID) or better site design. These additional measures would allow developments greater flexibility in meeting the more restrictive loading requirements. This would require the need for new procedure to be put in place to make sure that LID is incorporated into the review process. Developments still unable to meet the loading requirements may be required to address the additional pollutant load by other means. This could include other measures within the Swift Creek Reservoir such as water quality pollutant trading, purchase of open or conservation space, alternative credit program or off-site treatment.

b. Study the feasibility of other types of pollutant trading options for protection of water quality in the Reservoir.

i. The following analyses would be the first two steps in such a feasibility study.

1) Assessment of Pollutant Baselines for Trading Purposes

This would involve determining the potential credit supply (or demand) available from the reservoir, as well as the baseline pollutant control or reduction requirements faced by landowners and developers (for developed land, as well as land that may be developed, or otherwise undergo a change in use).

2) Projection of Current and Future Loads Under the Current Management Program

This would involve an analysis that might produce an "Expected" future load pattern, as well as a "Low" and a "High" case that would reflect different assumptions about growth rates and implementation of on-site or other controls. The current land-use plans have already been modeled. Other scenarios may be developed based on different site design within the context of current zoning.

A summary of currently available estimates for loading to the Reservoir and a preliminary assessment of potential credit supply, and technical issues that would need to be addressed ahead of, or as part of the trading analysis, would be identified as part of the short-term and long–term assessments.

ii. The second of two steps in the feasibility study would develop alternative trading scenarios to be considered and evaluate them against key decision criteria.

1) Development of Alternative Trading Frameworks

Based on the comparison of future projected loads without trading to a target loading cap necessary to meet water quality goals, one or more trading frameworks would be developed for consideration. These could be complementary, or mutually exclusive. For example, it is possible that the reservoir could serve as a "County Credit Bank", from which the County could allocate or sell phosphorus reduction credits to developers, under certain rules. Additionally, it may be desirable or necessary to foster a "private" market, whereby developers and existing landowners that reduce loads below their baseline responsibilities could sell credits to developers that cannot technically or cost-effectively meet their on-site baseline requirements.

2) Evaluation of "With Trading" Scenarios Against the Base Case

In this step, key decision criteria would be established to define feasibility and used to evaluate and compare the scenarios. This step would involve projecting future loads under each scenario, as determined by the trading rules and assumptions about how those rules influence credit demand and supply.

c. Develop potential modifications to the "Swift Creek Reservoir Watershed Master Plan"

i. Identify and Evaluate Alternative & Additional Treatment Measures

Additional treatment measures should be developed that could be funded by the future pro-rata fees and expansion of previously identified treatment measures to new locations. This may include the plan to be modified on an interim basis, then modify more completely as part of the longer-term actions. These measures would be used to reduce pollutant loads to the reservoir and may include the following types of projects:

- Restoration, protection and enhancement projects
    - Streams, wetlands and riparian buffer
- Stormwater management and source controls – <u>existing</u> developments and <u>retrofitting</u>
    - Retrofit stormwater facilities and existing ponds
    - Retrofit culverts and drainage systems, including vegetated open channels
    - Outfall controls (end of pipe treatments or facilities that divert smaller storms, provide energy dissipation, and/or treatment of stormwater)
    - Wetland and Stream Channel protection
    - Bioretention facilities, where soils permit
    - Allow more use of rain barrels and dry wells for citizens' homes and businesses
    - Manufactured BMPs (non-residential areas only)

3. **Long-term (should be addressed in the period ending October 2007)**

The tasks outlined below are to address additional stormwater management treatments, designs, pollution prevention, and ordinances that would influence pollutant loadings. Additional monitoring and maintenance programs that should be developed to ensure goals are met.

a. Contributions and Reduction of Pollutant Loadings

i. Compensatory Mitigation Projects

The county should actively pursue compensatory mitigation projects or stream mitigation bank to help address stream and wetland restoration potential within the Swift Creek Reservoir Watershed.

ii. Determine the impact of any additional TP contributions not addressed as part of the current model

These could include stream erosion, failing septic systems, animal contributions and phosphorus cycling in the reservoir, changes in development practices, construction contributions and loss of natural treatment systems (i.e. wetlands, stream connection with flood plains, decrease/increase ground water inputs).

iii. Certain TP removal mechanisms were not accounted for in modeling efforts

Modeling did not take into account those BMPs or lakes/ponds that currently exist, and the additional Resource Protection Areas (RPA) as a result of the on-site determinations. This would result in a decrease of TP loads to the reservoir.

b. Tracking System for Expenses and Evaluation

Develop a watershed tracking system for stormwater treatment and facility evaluation. Develop a time line to include periodic modeling, updates and analysis of watershed data to track goals. Pilot studies may be conducted of two watersheds with the greatest amount of development (i.e., Little Tomahawk and West Branch).

c. Modifications to Site Plan and Subdivision Ordinances

Conduct a complete review of site plan and subdivision ordinances to incorporate consistent standards for modified site design, modified housing densities and smaller lot sizes, reduced impervious surfaces through measures such as modified street widths, reduced setbacks and frontages, modified parking ratios, shared driveways, green area set-asides, and tree preservation.